



Piezo Transmitter Module PTM 100

User Manual V1.4
June 2004

Revision History

The following major modifications and improvements have been made to the first version of this document (PTM 100 User Manual, V1.0):

Version	Major Changes
1.1	No major changes as far as the content is concerned
1.2	Chapter 4 "Development Tools" added
1.3	No major changes as far as the content is concerned
1.4	- Chapter 1.6 "Ordering Information" revised - Chapter 2.3 "Radio Telegram of PTM 100" revised - Chapter 3.1 "Rocker Model" added - Chapter 3.5 "Approval Requirements" revised - Chapter 5 "Declaration of Conformity" added

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Important!

This information describes the type of component and shall not be considered as assured characteristics. No responsibility is assumed for possible omissions or inaccuracies. Circuitry and specifications are subject to change without notice. For the latest product specifications, refer to the EnOcean website: <http://www.enocean.com>.

As far as patents or other rights of third parties are concerned, liability is only assumed for modules, not for the described applications, processes and circuits.

EnOcean does not assume responsibility for use of modules described and limits its liability to the replacement of modules determined to be defective due to workmanship. Devices or systems containing RF components must meet the essential requirements of the local legal authorities.

EnOcean GmbH does not recommend the use of its products in life support applications and will not knowingly sell its products for use in such applications unless it receives an adequate "products liability indemnification insurance agreement".

Components of the modules are considered and should be disposed of as hazardous waste. Local government regulations are to be observed.

Packing: Please use the recycling operators known to you. By agreement we will take packing material back if it is sorted. You must bear the costs of transport. For packing material that is returned to us unsorted or that we are not obliged to accept, we shall have to invoice you for any costs incurred.

Table of Contents

Revision History	2
Table of Contents	3
1. GENERAL DESCRIPTION	4
1.1 Functional Principle	4
1.2 Typical Applications	5
1.3 Features Overview	5
1.4 Mechanical Interface	6
1.5 Environmental Conditions	9
1.6 Ordering Information	10
2. FUNCTIONAL DESCRIPTION	11
2.1 Block Diagram	11
2.2 Contact Nipples Designation	12
2.3 Radio Telegram of PTM 100	13
2.4 Serial Data Communication via Receiver Module RCM 120	15
2.5 Basic Switching Features via Receiver Modules RCM 110 and RCM 120	15
2.6 Learning of PTM 100 to RCM 110/120 Receivers	16
3. APPLICATIONS INFORMATION	17
3.1 Rocker Model	17
3.2 Construction of suitable Switch Rockers	18
3.3 Module Mounting	19
3.4 Transmission Range	19
3.5 Approval Requirements	19
4. DEVELOPMENT TOOLS	21
4.1 Evaluation Kit EVA 100	21
4.2 On-Board Overview EVA-PCB	21
4.3 EVA 100 Scope of Supply and Ordering Information	21
5. DECLARATION OF CONFORMITY	22

1. GENERAL DESCRIPTION

The radio transmitter module PTM 100 from EnOcean enables the implementation of wireless remote controls without batteries. Power supply is provided by a built-in piezo power generator.

The PTM 100 module serves the 868 MHz air interface protocol of EnOcean. Together with the receiver modules RCM 110 or RCM 120, this module can be easily integrated in operation and control units for the implementation of different application-specific system solutions.

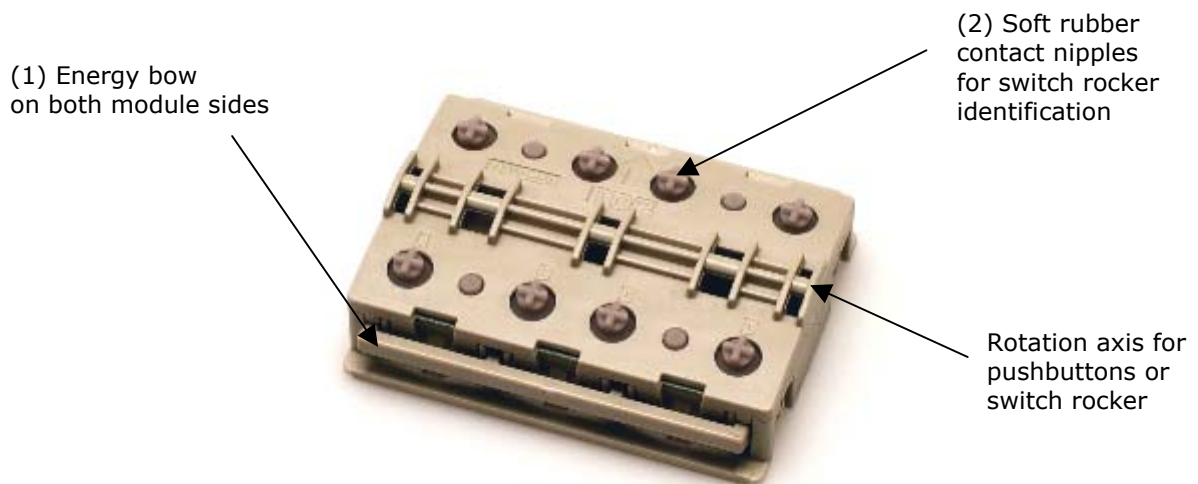


Figure 1: Piezo-radio transmitter module PTM 100

1.1 Functional Principle

A common piezo energy transducer is actuated by a bow (1), which can be pushed from outside the module on the left or right by an appropriate pushbutton or switch rocker. When the energy bow is pushed down, electrical energy is created and an RF telegram is transmitted including a 32-bit module ID. Releasing the energy bow generates different telegram data, so every PTM telegram contains the information that the bow was pressed or released.

„Long“ or „Short“ pushbutton operation (the time between pushing and releasing the pushbutton) can be easily detected by the receiver. By doing that, applications as Dimming control or Jalousie control inclusive Slat-acting can be simply realized.

In addition, the PTM telegram transmits the operating status of the contact nipples (2) when activating the bow. This enables the identification of up to 4 appropriate switch rockers or up to 8 pushbuttons.

1.2 Typical Applications

- **Building installation**
- **Industrial automation**
- **Consumer Electronics**

Key applications are wall-mounted flat rocker switches with 1, 2 or 4 rockers (with medial position), as well as handheld remote controls with up to 8 single pushbuttons.

The PTM 100 module is part of a powerful RF system solution from EnOcean for operation and control applications. Because the RF transmitters are self-powered (no batteries), maintenance-free RF systems are possible. The PTM modules operate together with the following additional EnOcean components: RCM (general-purpose radio receivers), STM (solar-powered wireless sensors), CTM (remote control) and TCM (bi-directional IT interface)

1.3 Features Overview

Power Supply:	 power generation by rocker pressing (Piezo Power Generator)
Frequency:	868.3 MHz
Transmission power:	max. 10 mW
Modulation type:	ASK
Data rate:	120 kbps
Channel bandwidth:	280 kHz
Antenna:	 integrated
Transmission range:	 approx. 300 m free field
Number of Channels:	 4 channels with 4 action states each (upper/lower contact nipple is pressed/released)
Module identifier:	 individual 32 bit ID (factory programmed)

1.4 Mechanical Interface

Module dimensions: 53.0 x 44.5 x 14.85 mm
(energy bow in pressed position)

Module weight: 24.5 g

Energy bow travel / operating force: 3.5 mm / 7.5 N $\pm$ 0.5 *)

Tapping rod travel / operating force: 0.8 $\pm$ 0.1 mm / 1.2 N *)
*) at room temperature

Number of operations: > 50.000 actuations tested according to VDE 0632 / EN 60669

Cover material: Makrolon 8030 (PC-GF 30)

Energy bow material: Ultradur B 4040 G10

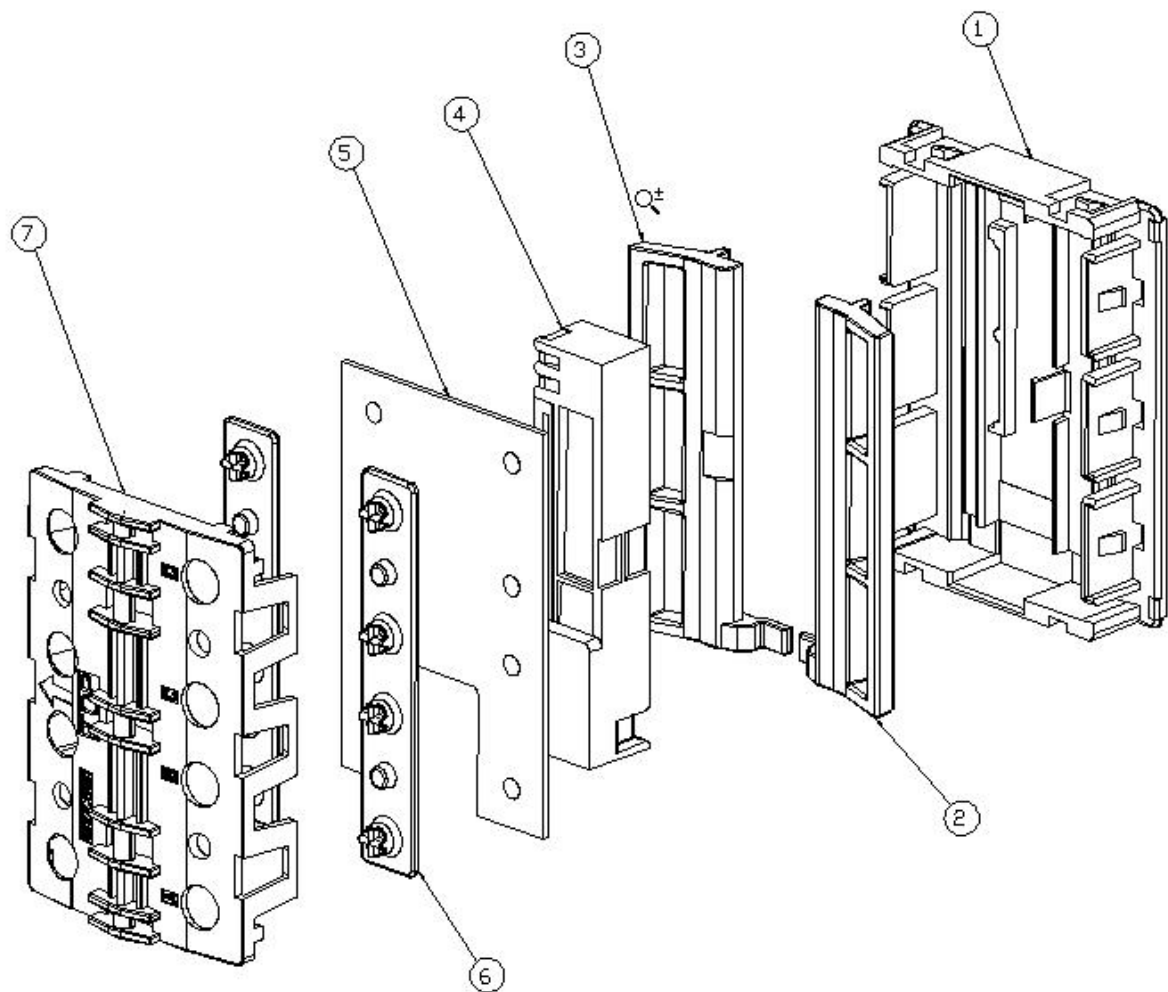


Figure 2: PTM 100, exploded view

- 1 Base Tray
- 2,3 Energy Bows
- 4 Piezo Generator
- 5 PCB
- 6 Soft rubber contact nipples
- 7 Case cover

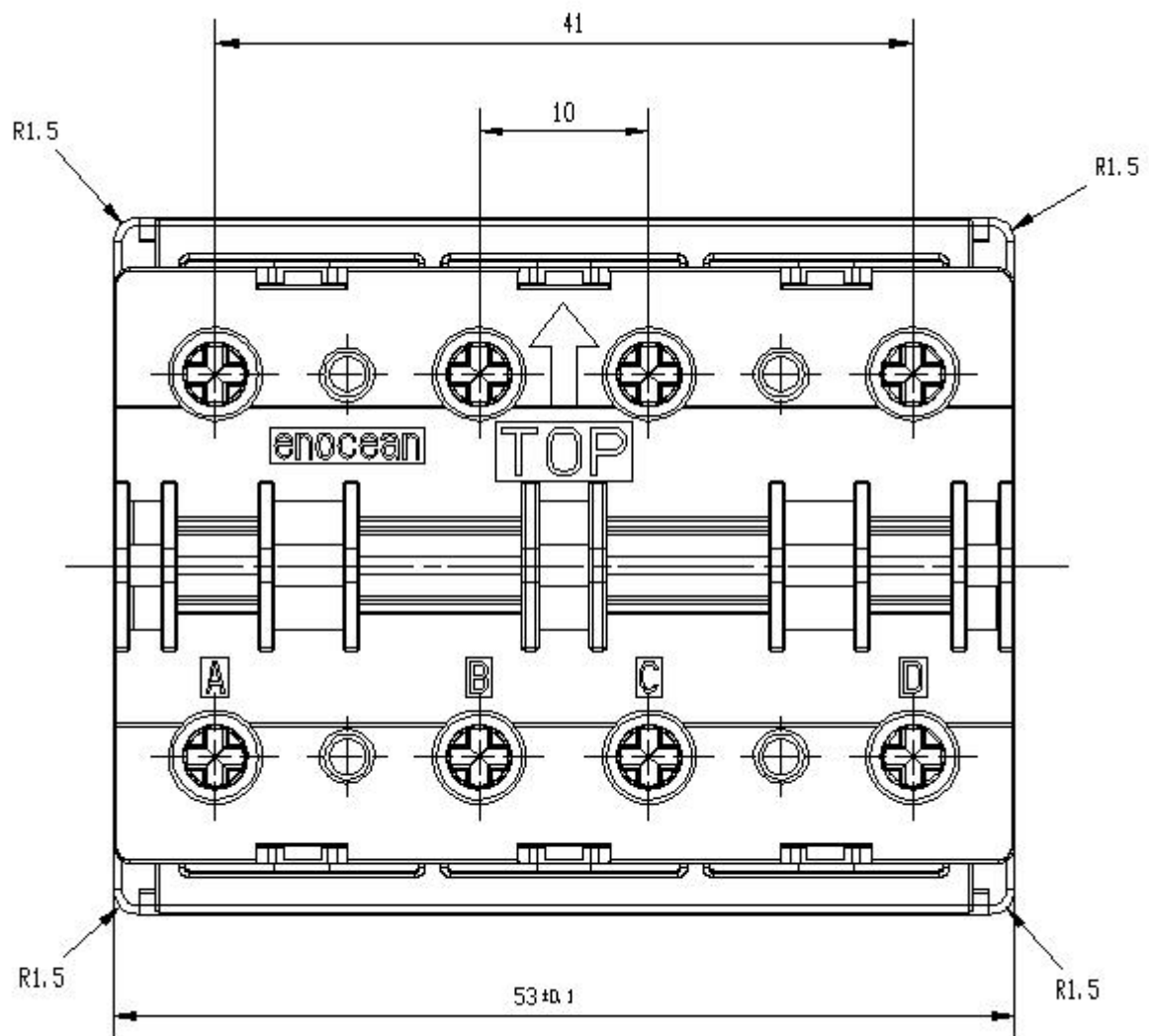


Figure 3: PTM 100, top view

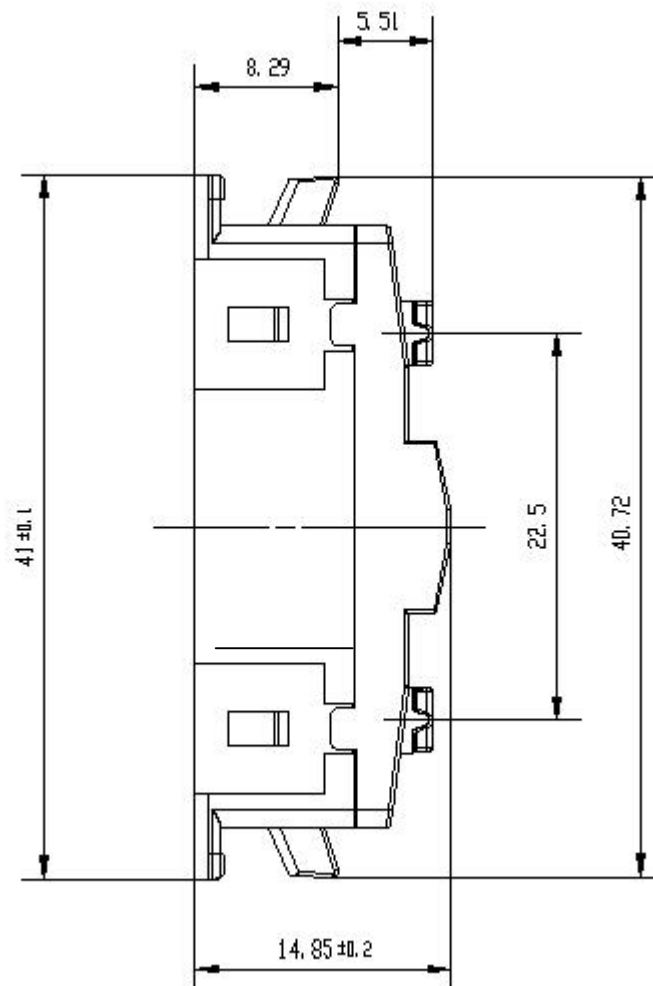
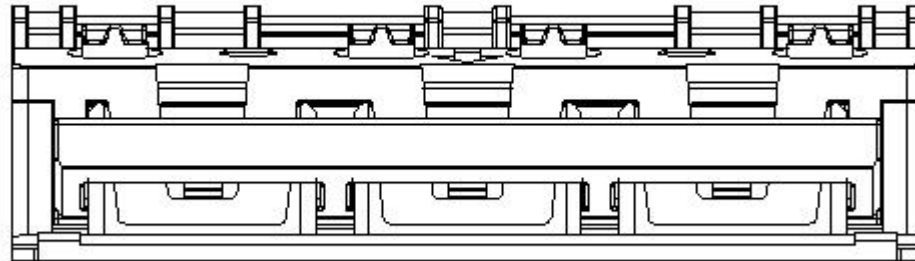


Figure 4: PTM 100, side view

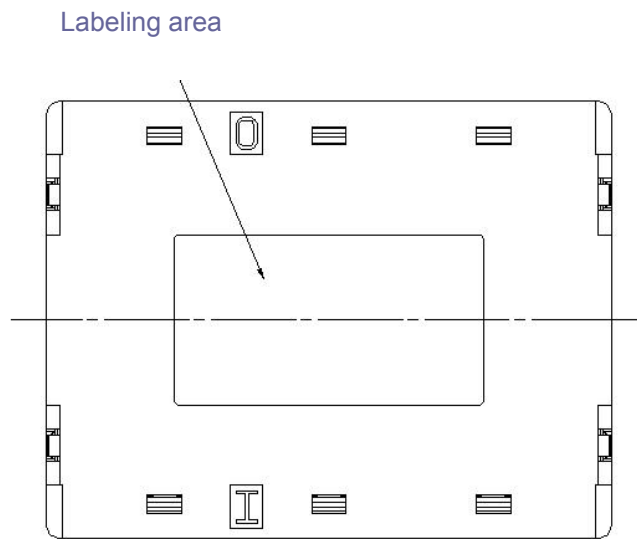


Figure 5: PTM 100, rear view

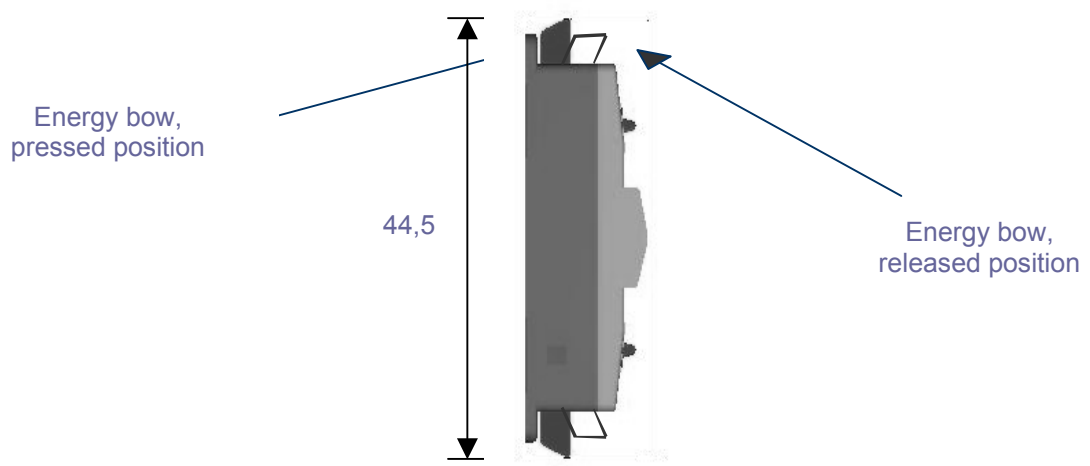


Figure 6: Start and end position of energy bow

1.5 Environmental Conditions

Operating Temperature:..... -25 up to +65 °C

Storage Temperature: -40 up to +85 °C, +85 up to +100 °C for 1h max.

Humidity:.....0 % to 95 % r.h.

1.6 Ordering Information

Type	Ordering Information
PTM 100 Piezo Transmitter Module	EnOcean Ordering Code: S3001-A100
PTM 100 Rocker Model (Development Tool)	Please send an Email to info@enocean.com
IGS Data of PTM 100 Rocker Model (see chapter 3.1)	Free Download from www.enocean.com
IGS Data of PTM 100 module case (see chapter 3.2)	Free Download from www.enocean.com

2. FUNCTIONAL DESCRIPTION

2.1 Block Diagram

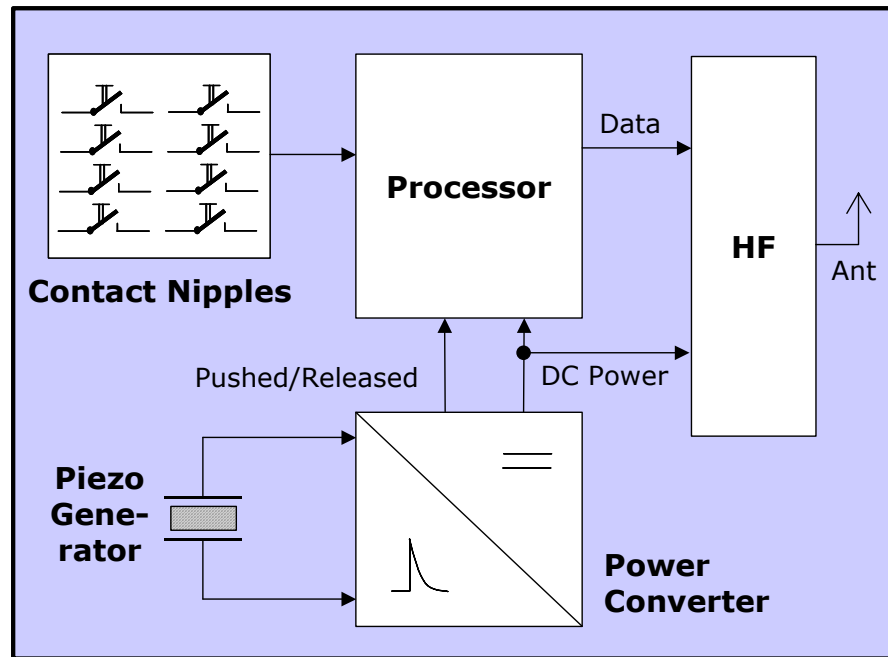


Figure 7: Block diagram of PTM 100

Piezo Generator

Converts pressure on the energy bow into electrical energy.

Power Converter

Electronic converter unit for generating the module DC power supply

Processor

Converts the contact nipples' status and pushed/released data from the power generator into a reliable and energy-efficient serial telegram structure.

HF transmitter

Sends the data in the form of a series of short radio signals.

2.2 Contact Nipples Designation

With 8 soft rubber contact nipples, the PTM 100 offers 4 channels with 4 action states each (upper/lower nipple is pressed/released when activating the energy bow). The nipples' designation is as follows:

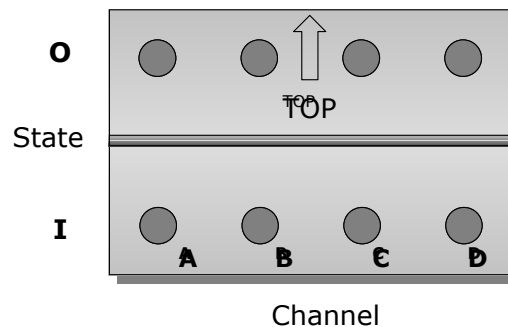


Figure 8: Contact nipple designation

Radio signals of the PTM 100 module are event-controlled (energy bow is pressed/released) with contact nipple code (channel/state) and unique module identification (fixed 32-bit ID). When operating more than one nipple at the same time, note that PTM 100 does not send multiple-button code combinations (switch module of Type 1):

- Only one contact nipple was pressed when activating the energy generator → Message with nipple code and pressed/released event status of the energy bow is sent (**N-message**).
- No contact nipple was pressed when activating the energy generator, or more than one nipple was pressed → Message with number of pressed nipples and pressed/released event status of the energy bow is sent (**U-message**).

Note: Due to the mechanical hysteresis of the piezo energy bow, in most rocker switch device implementations, pressing the rocker sends a N-message and releasing the rocker sends an U-message!

2.3 Radio Telegram of PTM 100

For the transmission of the telemetric signals, EnOcean has defined a new dynamic radio data telegram that is adapted to the individual application. It is optimized to the essential features of energy autarkic radio sensors:

- Lowest energy demand
- Possibility of operating hundred of senders within the same radio cell
- Highest transmission reliability
- Wide transmission range
- Easy extensibility
- Suitable for uni- and bidirectional communication
- Flexibility for adaptation of different data structures and data quantities
- Possibility of data encryption

2.3.1 Frequency range and transmission cycle allowed

The EnOcean technology operates the 868.3 MHz radio channel, which is exclusively released for short-time data transmission in Europe. All transmitters have to stick to a duty cycle of maximal 1% within one hour. Permanent transmitters such as radio earphones are not allowed. For conventional applications, it must be ensured that the PTM 100 radio module is not operated more than 9000 times within one hour (Energy bow pressed and released. Within this calculation the extraordinary short telegram length is considered inclusive three subtelegrams, see chapter 2.3.3. Also a tolerance of 10% in telegram length is included).

2.3.2 Modulation process

As modulation process, EnOcean uses incoherent amplitude modulation (ASK). Digital amplitude modulation enables the implementation of very efficient energy-saving transmitters because only the "1"-bits are transferred. At the same interference signal level, the transmission security of the alternative FSK method is identical to that of the ASK method (Reference: Pehl, Digitale und analoge Nachrichtenübertragung, Hüthig 2001).

2.3.3 Transmission timing

The transmission timing of the radio module PTM 100 has been developed to avoid possible collisions with data packages of other EnOcean transmitters as well as disturbances from the environment.

With each transmission cycle, at least three identical subtelegrams are transmitted. The transmission of a subtelegram lasts approximately 0.6 ms. To optimize data security, each telegram is repeated twice within about 20 ms, whereas the delay between the second and the third transmission burst is effected at random. If some left over energy is available after transmission of three subtelegrams, further subtelegrams will be send.

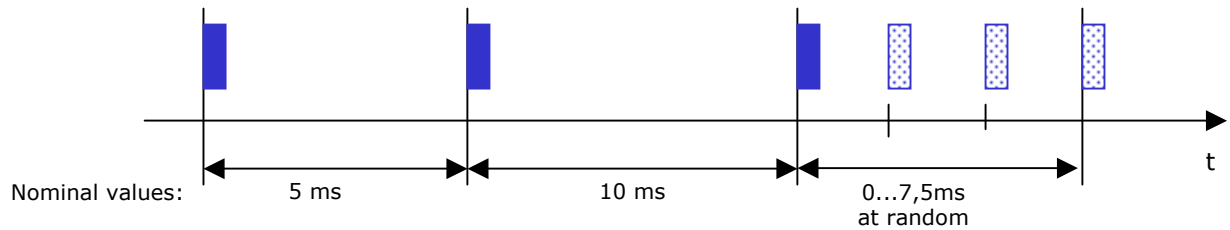


Figure 9: PTM 100 radio timing

2.3.4 Reliable radio transmission within systems operating many sensors

The very short telegrams of EnOcean transmitters enables to operate a lot of senders within the same radio cell, the error rate in cause of telegram collisions remains extremely low. Statistically viewed, the transmission reliability is still bigger than 99.99% in the case of 100 radio sensors that transmit once every minute. This means that even large office buildings and also huge industrial facilities can be equipped with a lot of sensors of this kind of radio technology.

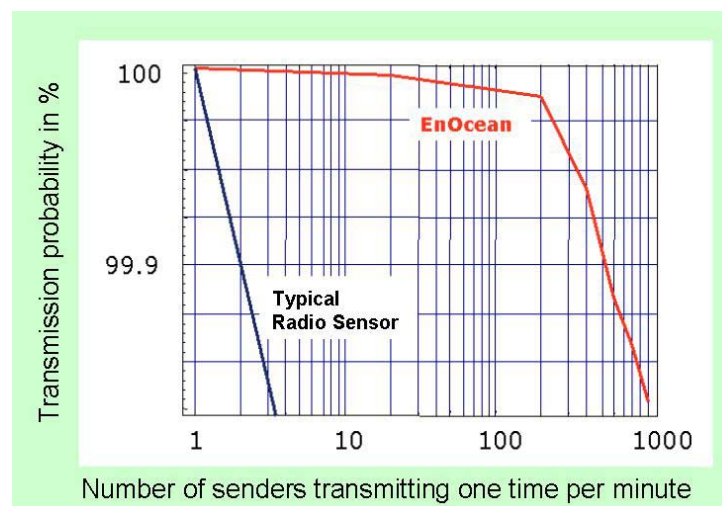


Figure 10: Probability of transmission failure caused by radio data collision for EnOcean light switch transmitter PTM 100

2.4 Serial Data Communication via Receiver Module RCM 120

The **RCM 120 Receiver Module** of EnOcean enables standard asynchronous communication to a microcontroller or personal computer (9600 bps, 1 start bit, 8-bit data byte with LSB first, 1 stop bit) with a decompressed and simple data structure.

When the RCM 120 receiver is set to Mode 0 "Serial Interface", it transfers out data blocks of information from the received RF telegrams. For a complete transmitter message, a telegram of 14 data bytes is transferred via the serial link.

The data block format is explained in detail in the RCM 110/120 User Manual.



Figure 11: Receiver modules RCM 110 and RCM 120

2.5 Basic Switching Features via Receiver Modules RCM 110 and RCM 120

The multifunctional **RCM 110 and RCM 120 Radio Receiver Modules** are used to receive and process telegrams generated and transmitted by EnOcean radio transmitters. Via functional control outputs (open collector), these modules can be easily integrated into control and switching units for the implementation of different application-specific system solutions.

RCM 110 output switching functionalities:

- Basic signal output functions "switching" (On/Off): 1, 2 or 4 channels
- Basic signal output function "dimming": On/Off (pushbutton operated quickly) and PWM 50 kHz (pushbutton pressed for a longer time) with switch-off value memory
- Scene selection control: ALL On/Off, 6 scene memories
- Learning procedure for EnOcean transmitters, easy to operate

RCM 120 output switching functionalities:

- Basic signal output function "pushbutton": 1 channel
- Basic signal output function "tubular motor control" (Up/Down with slat acting): 1 or 2 channel
- Learning procedure for EnOcean transmitters, easy to operate

Any further switching functions can be simply and flexible realized using the serial interface output of the RCM 120 that is connected to a low-priced microcontroller. The required output control logic can be easily programmed by the user.

2.6 Learning of PTM 100 to RCM 110/120 Receivers

The piezo radio transmitter PTM 100 can be easily made known to the receiver RCM 110 or RCM 120 that has been set into learn mode through triggering a PTM 100 radio signal by operating the energy bow when pressing either the O-rod or the I-rod of the desired channel A, B, C or D.

If the receiver RCM 120 is operated at mode 0 "Serial Interface", telegrams from learned PTM 100 transmitters are signed (see RCM 110/120 User Manual).

3. APPLICATIONS INFORMATION

3.1 Rocker Model

For evaluating the PTM 100 a neutral model of a double-rocker is available from EnOcean, that can be easily snapped onto the PTM 100 module case:



Figure 12: Rocker Model for PTM 100



Figure 13: Rocker model snapped onto the module

Please note that pressing the rocker sends a N-message and releasing the rocker sends an U-message.

3.2 Construction of suitable Switch Rockers

For CAD system development support, 3D construction data of the rocker model of chapter 3.1 are available from EnOcean (IGS data).

Using this data the mechanical interface is fixed, shape and surface of the rocker(s) can be changed in correspondence to the requirements. Recommendation for suitable rocker material is Ultradur B 4520 with a surface roughness of min. Ra 1,0 μm . For dimensioning the mechanical interface please also observe the following notes:

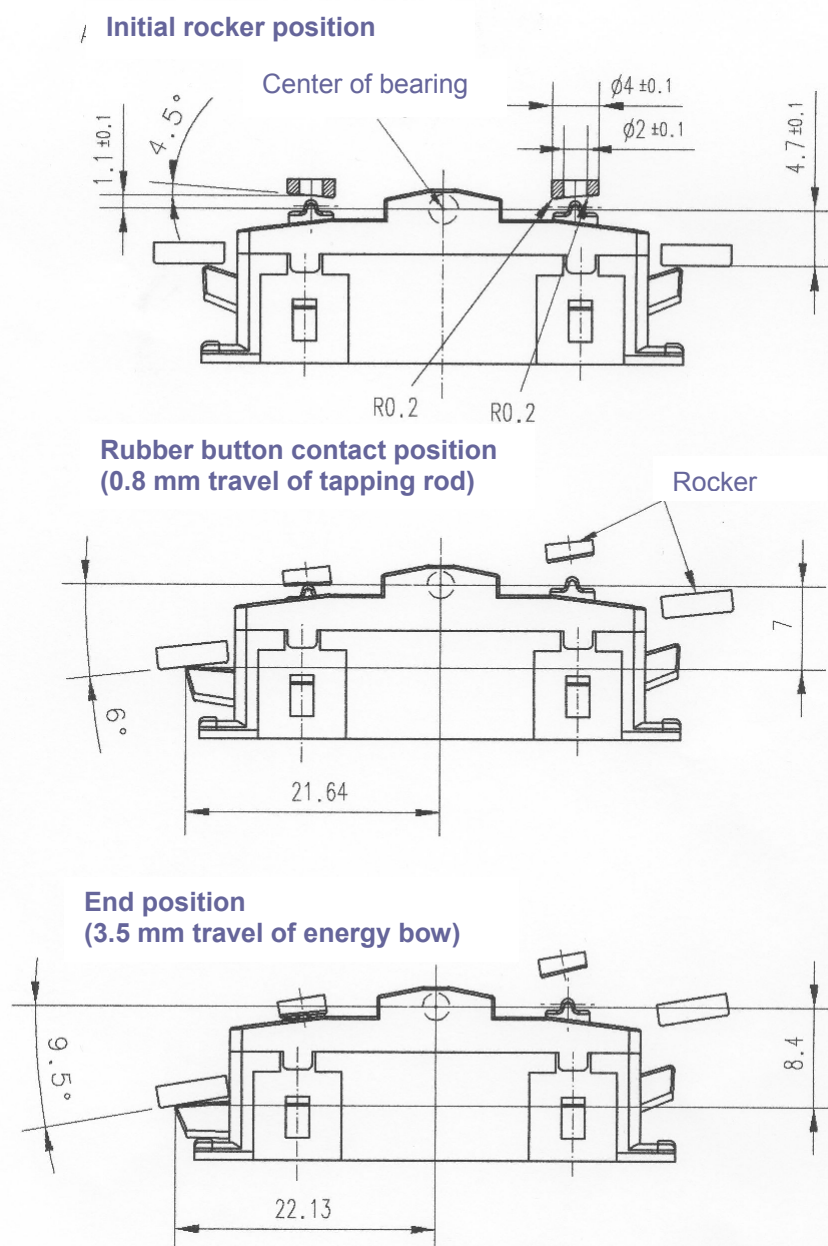


Figure 14: Construction of switch rockers

3.3 Module Mounting

For mounting the PTM 100 module into an application-specific case, the package outline drawings of the module are roughly dimensioned in 1.4 Mechanical Interface.

If more detailed dimensioning data of the PTM 100 module case is necessary, 3D construction data are available from EnOcean (IGS data).

3.4 Transmission Range

The main factors that influence the system transmission range are type and location of the antennas of the receiver and the transmitter, type of terrain and degree of obstruction of the link path, sources of interference affecting the receiver, and "Dead" spots caused by signal reflections from nearby conductive objects. Since the expected transmission range strongly depends on these system conditions, range tests should categorically be performed before notification of a particular range that will be attainable by a certain application.

The following figures for expected transmission range are considered by using the PTM 100 radio transmitter module and the RCM 110 or RCM 120 radio receiver module with the preinstalled whip antennas and may be used as a rough guide only:

- **30 m** for obstructed environment (e.g. through two brick walls inside a building)
- **300 m** for unobstructed environment ("free field")

Further notes to determine the transmission range within buildings are available as download from www.enocen.com

3.5 Approval Requirements

The modules bear the EC conformity marking CE and conforms to the R&TTE EU-directive on radio equipment. The assembly conforms to the European and national requirements of electromagnetic compatibility. The conformity has been proven and the according documentation has been deposited at EnOcean. The modules can be operated without notification and free of charge in the area of the European Union, in Switzerland, in Cyprus, in Czech, in Estonia, in Hungary, in Latvia, in Lithuania, in Malta, in Poland, in Romania and in Slovenia. The following provisos apply:

- EnOcean RF modules must not be modified or used outside their specification limits.
- EnOcean RF modules may only be used to transfer digital or digitized data.

Analog speech and/or music are not permitted.

- The final product incorporating EnOcean RF modules must itself meet the essential requirement of the R&TTE Directive and a CE marking must be affixed on the final product and on the sales packaging each. Operating instructions containing a Declaration of Conformity has to be attached.
- If transmitters are used according to the regulations of the 868.3 MHz band, a so-called "Duty Cycle" of 1% per hour for each transmitter must not be exceeded (also see chapter 2.3.1).

4. DEVELOPMENT TOOLS

4.1 Evaluation Kit EVA 100

EVA 100 is an evaluation kit to support a quite easy setting-up operation of the receiver side when the EnOcean transmitter module PTM 100 is evaluated. EVA 100 supports a quick evaluation of all RCM 110 and RCM 120 receiver operation modes and supports the fast development of applications.



4.2 On-Board Overview EVA-PCB



Symbol	Function
Adaptor	Female jack for power supply
RCM 100	Female header for plug-in RCM 110 or RCM 120 module
Test Connector	Female header connected directly to RCM leads
Vcc	Jack to disconnect RCM power supply
GND	Ground connector for control outputs
GND	
R0	Functional control outputs. Also indicate current learning mode status. R0..3 are directly connected to the OUT_0..3 output pins of RCM 110/120 module.
R1	
R2	
R3	
GND	Analog output to drive an Electronic Control Gear (with RCM 110)
EVG	
GND	50 kHz PWM output (with RCM 110)
PWM	
RS232	DB9 female connector (with RCM 120)

4.3 EVA 100 Scope of Supply and Ordering Information

Type	EnOcean Ordering Code	Scope of supply
EVA 100	H3004-G100	- Evaluation board EVA-PCB - EnOcean radio modules STM 100, PTM 100 (incl. Rocker Model), RCM 110 and RCM 120 - CD with PC-link monitor software and detailed kit documentation - Wall power supply for EVA-PCB - Convenient equipment case

5. DECLARATION OF CONFORMITY



EnOcean GmbH
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Declaration of Conformity



We: EnOcean GmbH
Kolpingring 18a
D 82041 Oberhaching
Germany

Declare: under our sole responsibility that the following labeled products:

Transmitter: PTM100, STM100

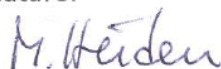
Receiver: RCM110, RCM120

to which this declaration relates are, when used according to specification in conformity with the technical requirements of the standards and the provisions of the essential requirements of the Directives detailed below.

Directives: Electromagnetic Compatibility Directive 89/336/EC
Radio and Telecommunications Terminal Equipment Directive R&TTE 1999/5/EC

Standards: ETSI EN 301 489-1: 2001-09, ETSI EN 301 489-3: 2001-11
ETSI EN 61000-6-2: 2002-08
ETSI EN 300 220-3: 2000-09

Place of issue: Oberhaching
Quality Manager:
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Signature:



Date of issue: 4. March 2004
General Manager:
Markus Brehler
Signature:

